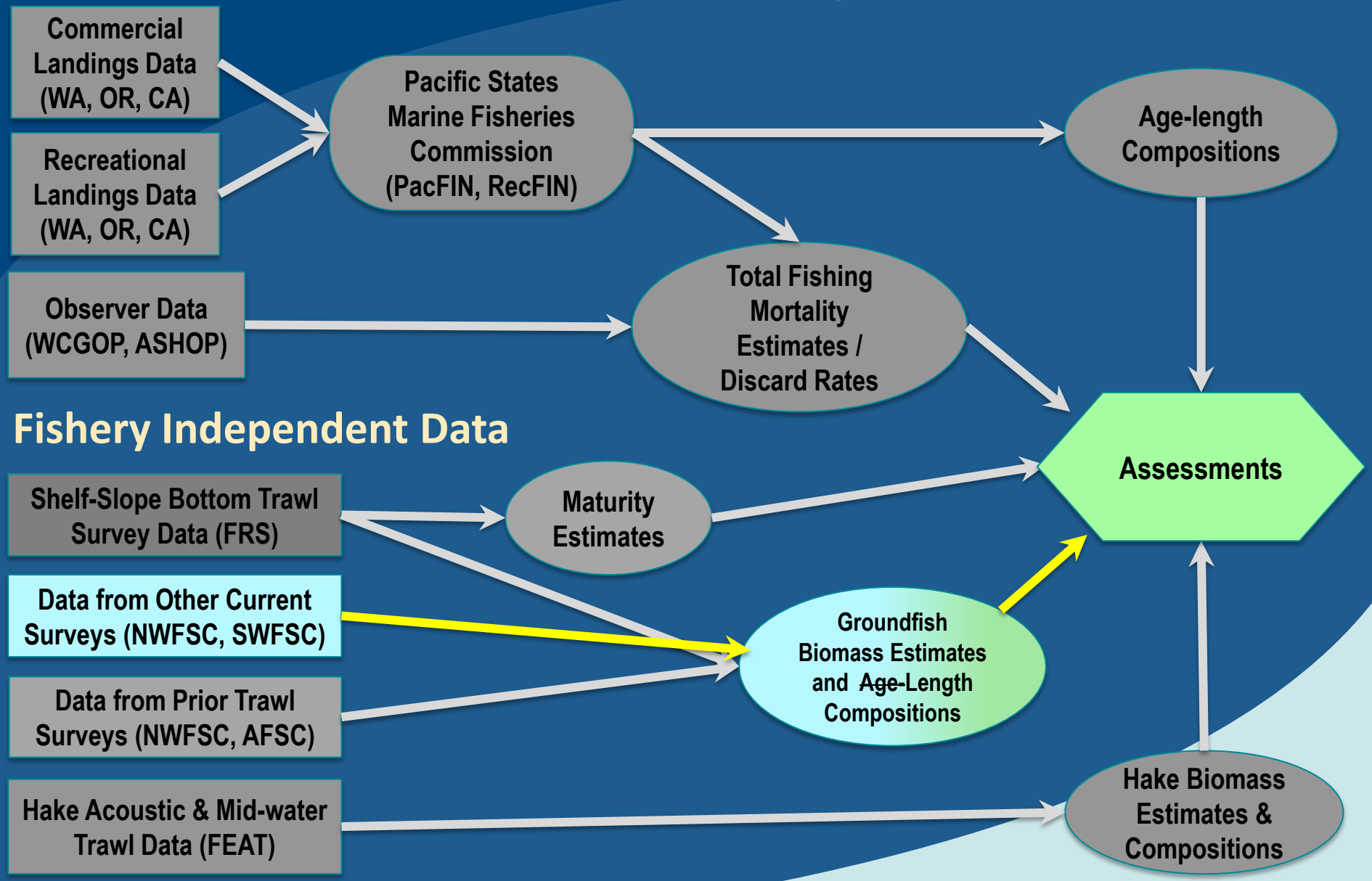
Fishery Independent Data from Visual Surveys With a Focus on Cowcod

NOAA FISHERIES

- Introduction
  - why visual surveys?
  - why cowcod?
- Survey description
- Data analysis and results
- Potential Biases and Sources of Uncertainty
- Benefits of Visual Surveys
- Challenges
- Solutions



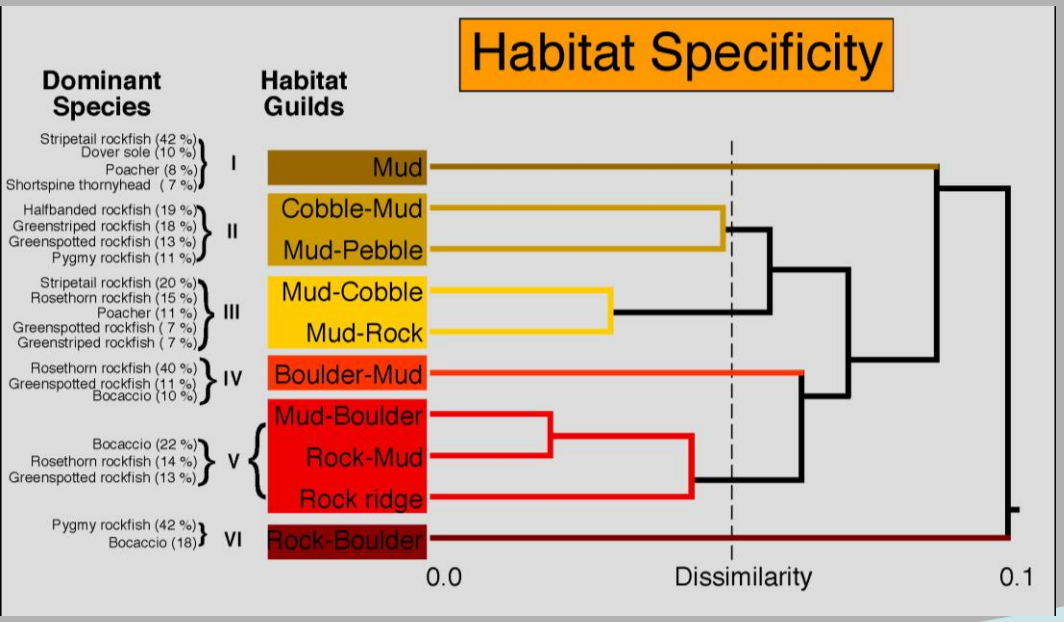

Fishery Data Flows



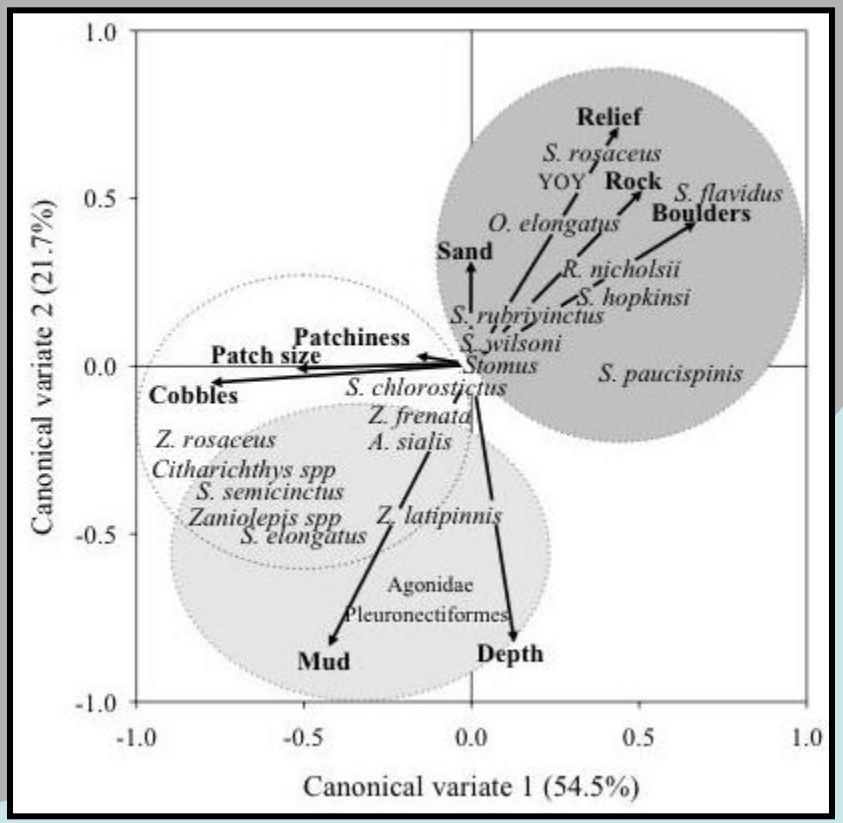
Deepwater Groundfishes and Habitats

It is difficult or impossible to accurately survey several of these species in complex rock habitats using conventional methods

Couple underwater visual survey methods with seafloor mapping to estimate absolute abundance

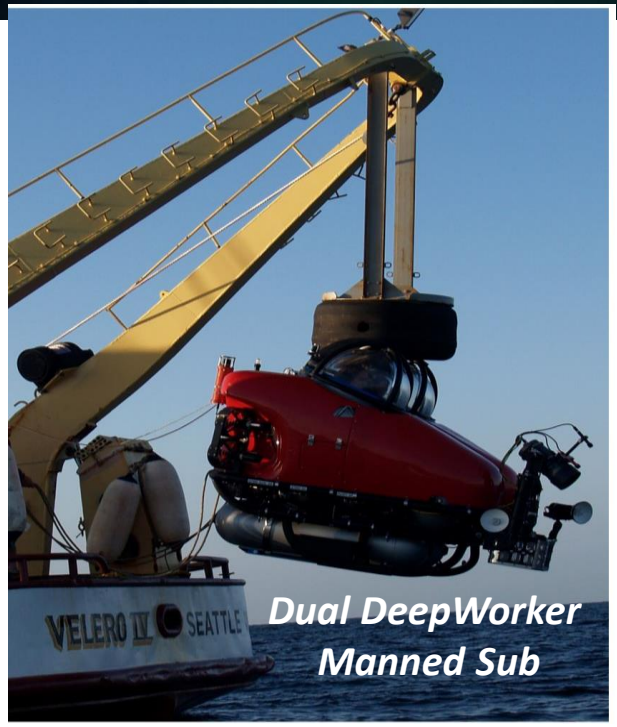


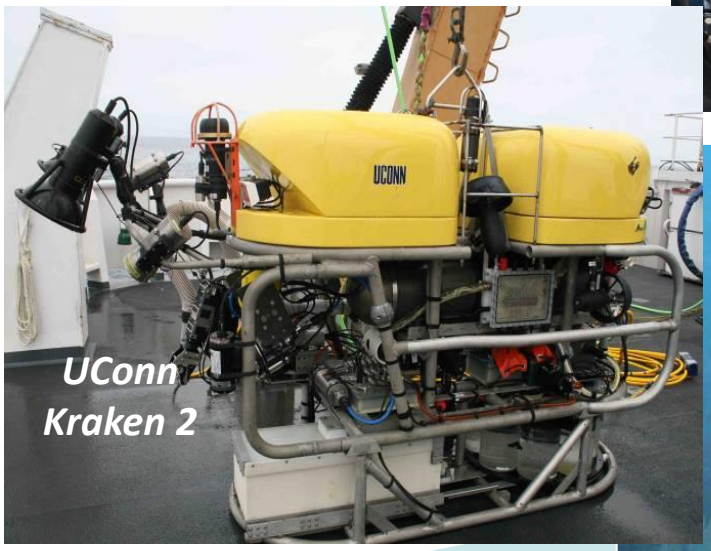
Yoklavich et al. 2000. Fishery Bulletin



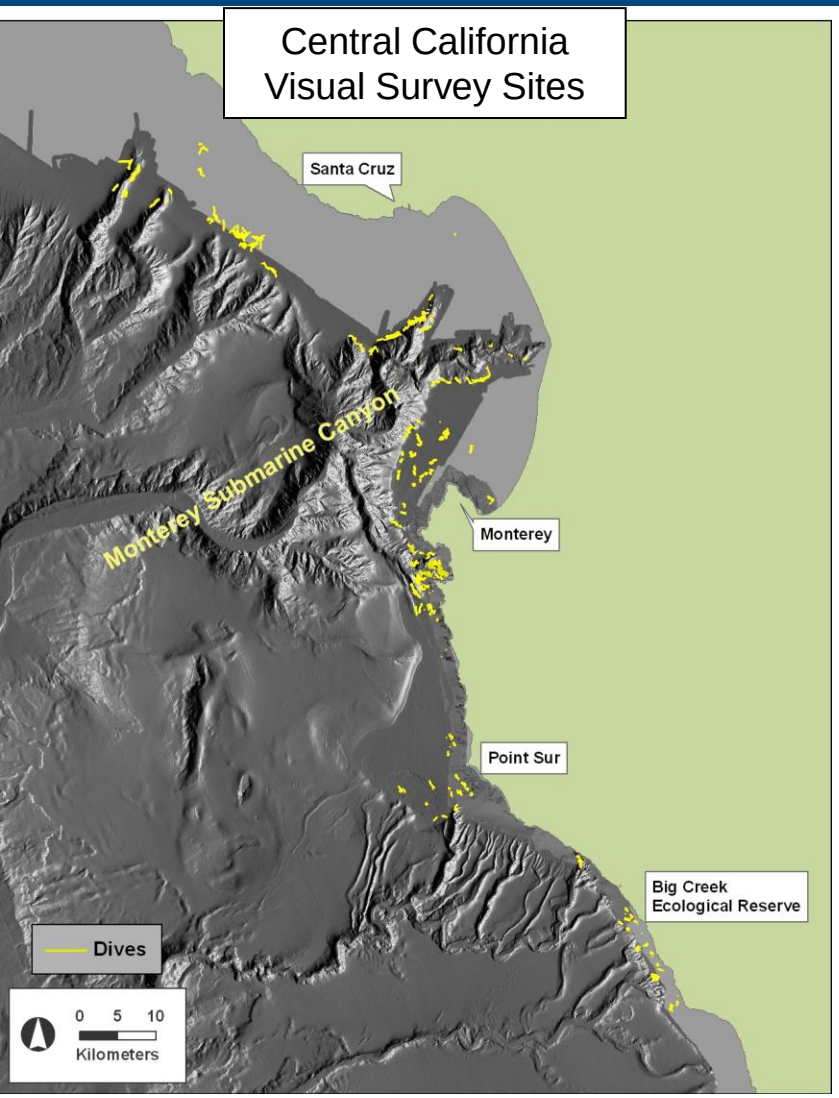
Anderson & Yoklavich. 2007. Fish. Bull.

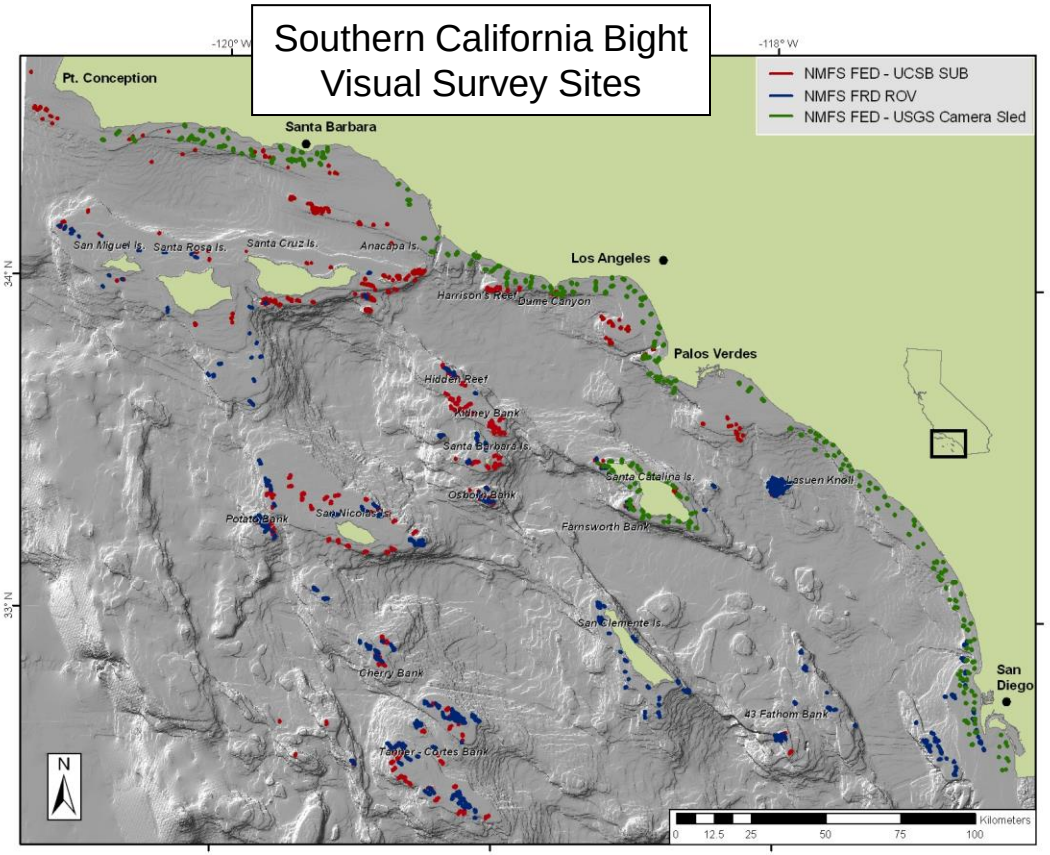
Visual Survey Tools We Use to Characterize Demersal Communities



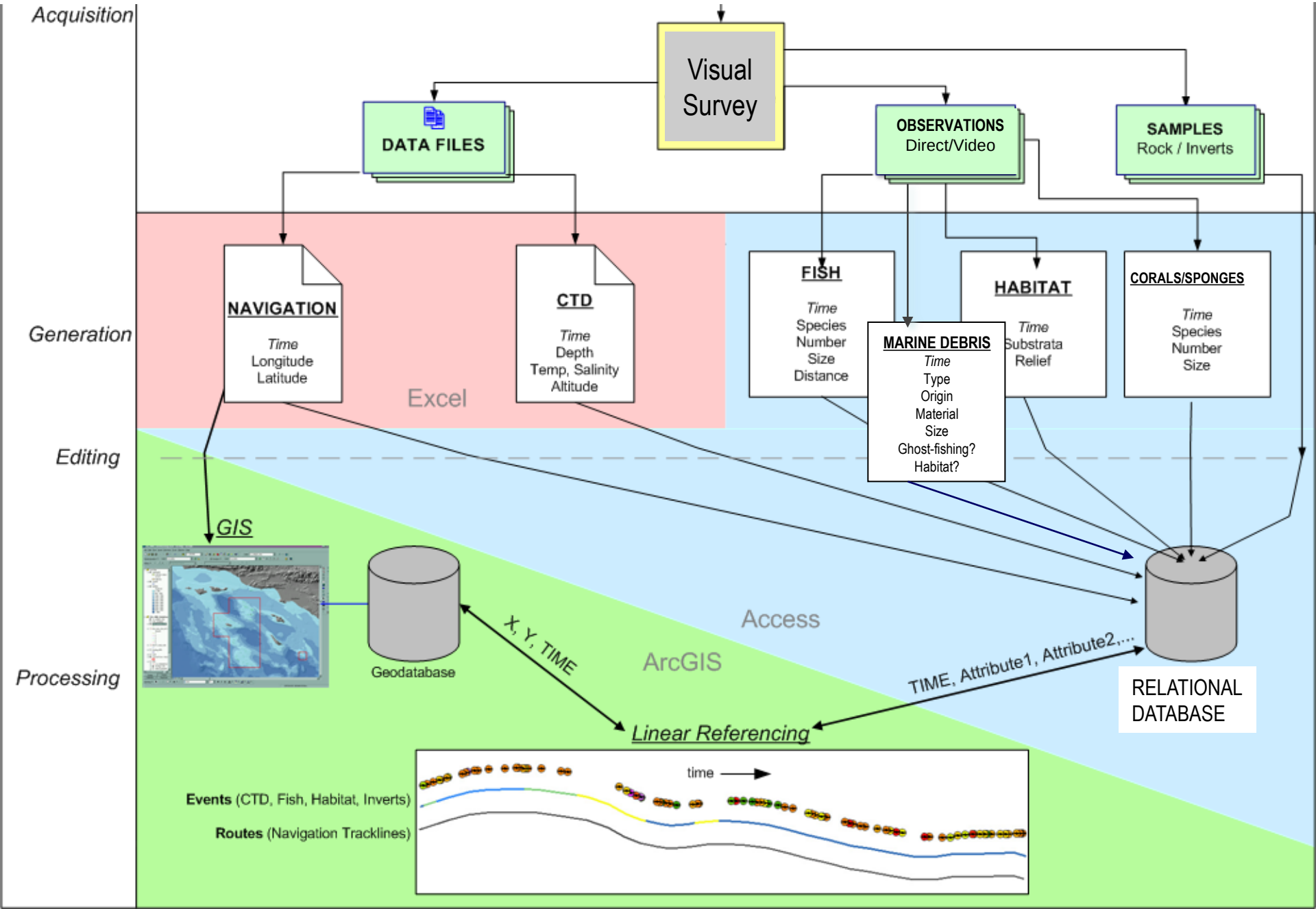


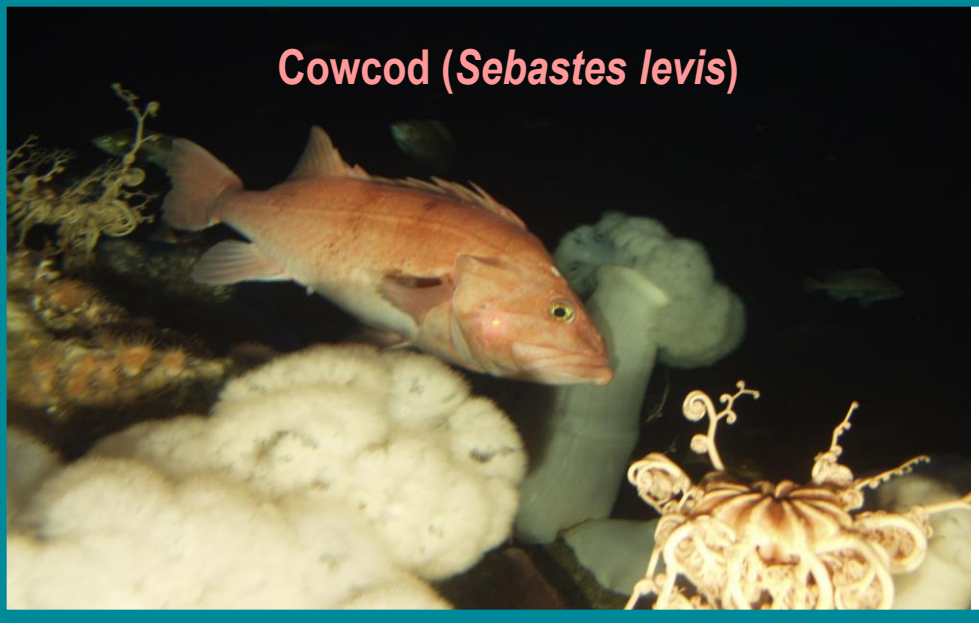
Distribution of Visual Surveys off California





Data Work Flow





Age: at least 55 years

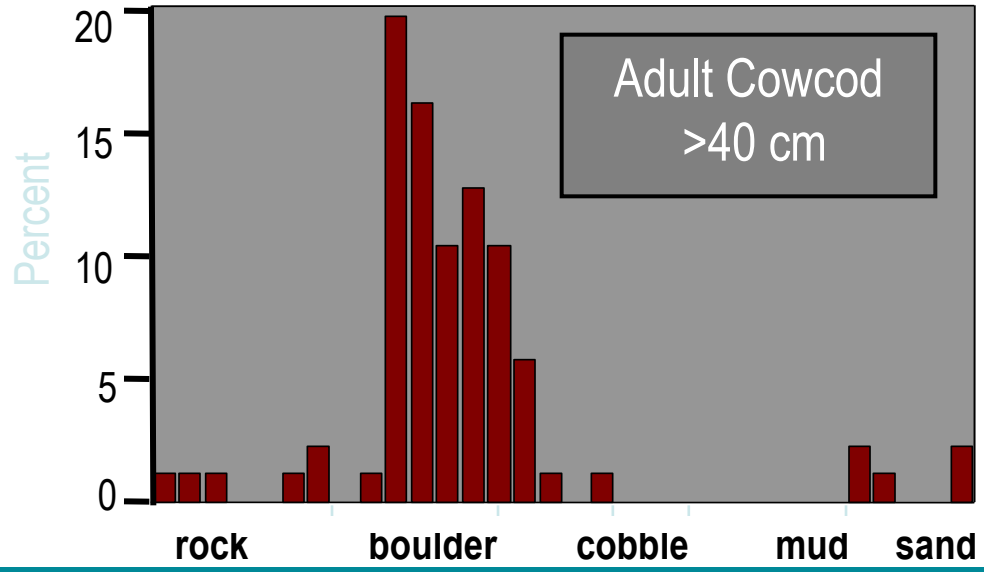
Maximum size: 100 cm

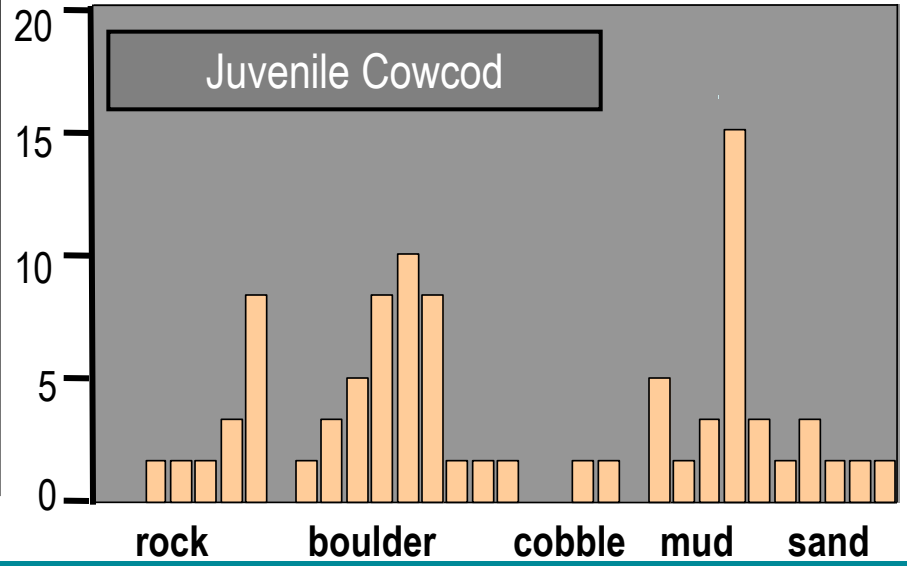
Depth: 20-490 m

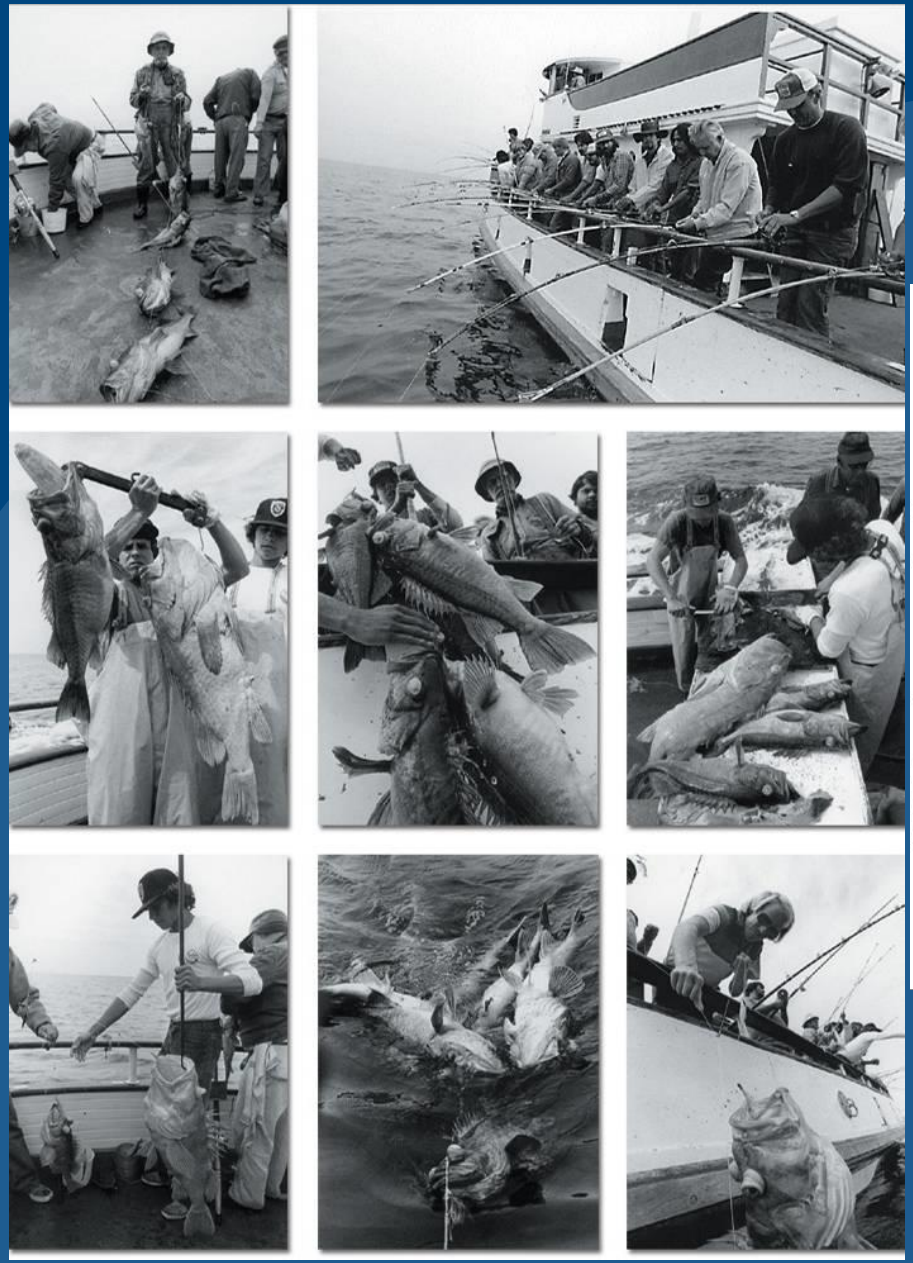
Sporadic recruitment (10-20 yrs)

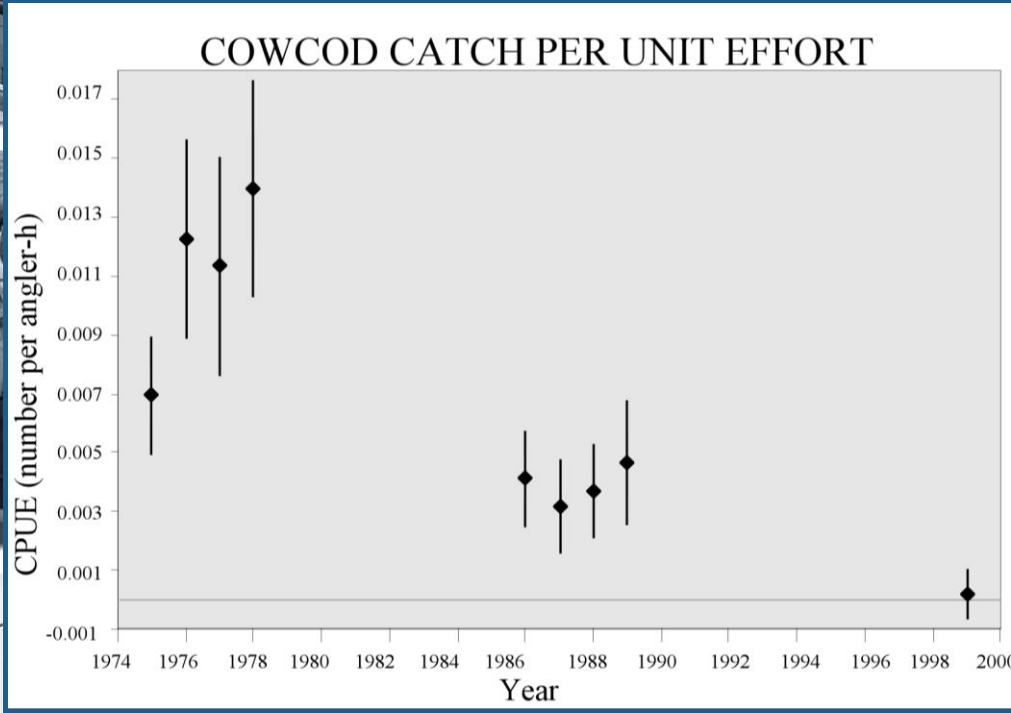
Sedentary Lifestyle

Habitat Specificity

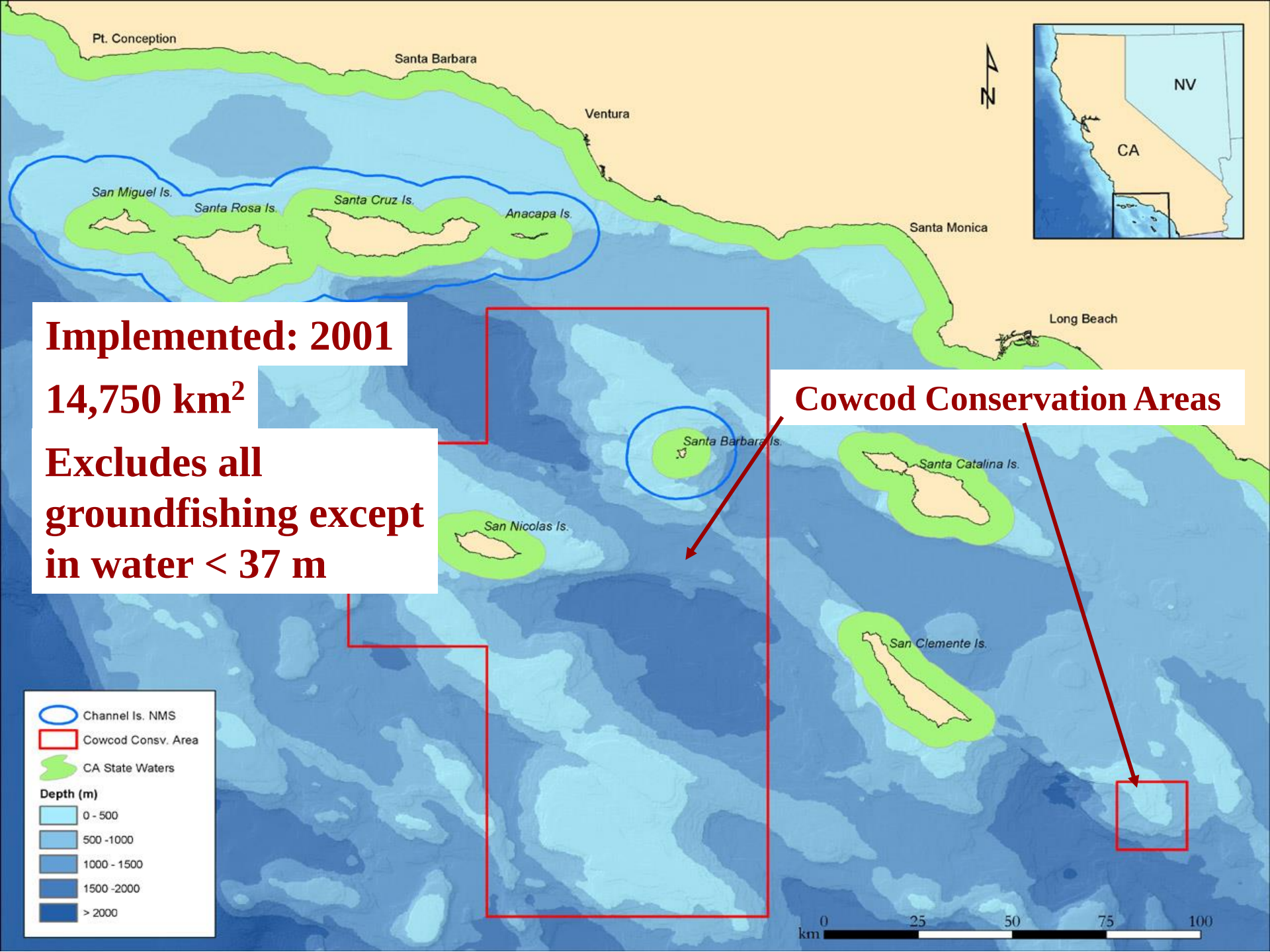








Source: CDFG Observer Data of CPFV


Pt. Conception
Santa Barbara
Ventura
Santa Monica
Long Beach
San Miguel Is.
Santa Rosa Is.
Santa Cruz Is.
Anacapa Is.
Santa Barbara Is.
San Nicolas Is.
Santa Catalina Is.
San Clemente Is.
N
NV
CA
Implemented: 2001
14,750 km²
Excludes all groundfishing except in water < 37 m
Cowcod Conservation Areas
Channel Is. NMS
Cowcod Consv. Area
CA State Waters
Depth (m)
0 - 500
500 -1000
1000 - 1500
1500 -2000
> 2000
0
25
50
75
100
km

Can we effectively survey cowcod rockfish by direct observations?

Are the Cowcod Conservation Areas meeting their objective to protect and rebuild cowcod population?

1. Collect baseline data on abundance, size, and distribution of all groundfishes in CCAs

2. Determine availability and use of benthic habitats, including structure-forming macroinvertebrates

2002 Cowcod Survey in partnership with colleagues at UC Santa Barbara (Love et al.)

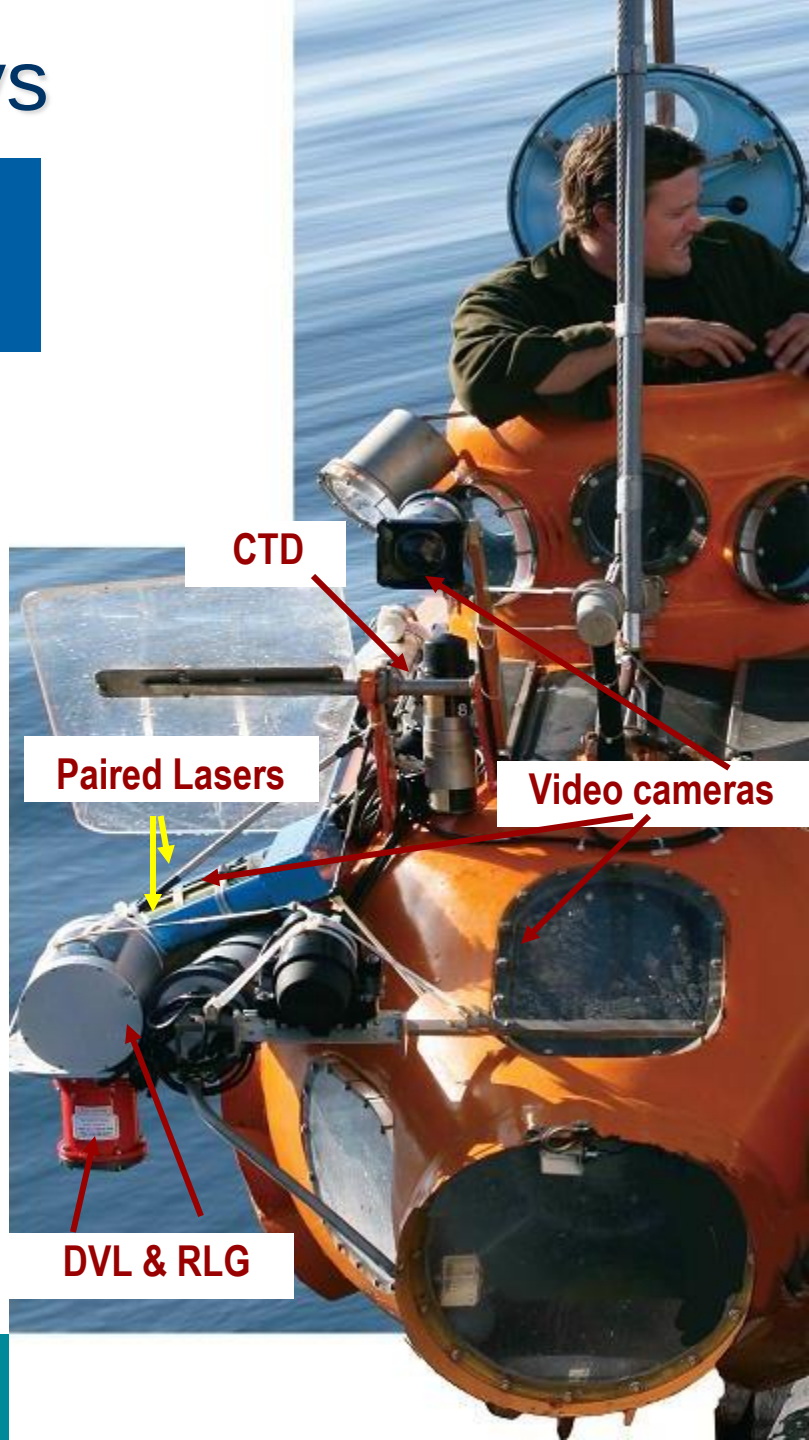
Funding from:

- David and Lucile Packard Foundation
- NOAA National Undersea Research Program
- NMFS Office of Protected Resources
- NMFS Office of Habitat Conservation
- National MPA Science Center

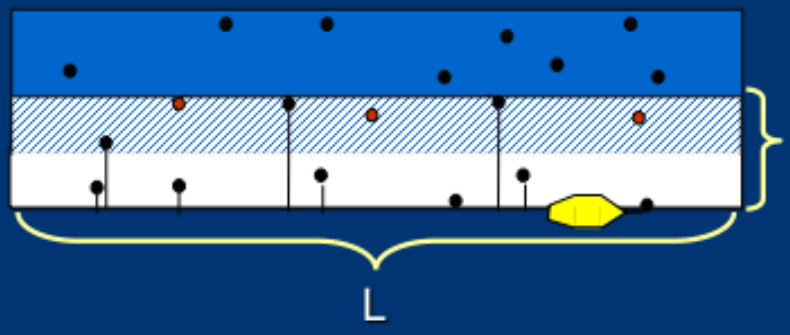
Habitat-based Visual Surveys

Manned Submersible
Primary Data Collection: Scientific Observer
Secondary Data Collection: Video

- Portable platform used on a variety of support vessels and in a variety of conditions
- Highly maneuverable and tractable in high-relief topography
- *In situ* observer enhances detection & identification of diverse communities in complex habitats
- Relatively small environmental impact (light, sound, motion)
- Quick and easy to deploy and retrieve
- Cost effective



Visual Transect Surveys



Strip Transect
→All Fish Except Cows
→Macro-invertebrates
→Substratum Type

Line Transect
→ Cowcod

$$D = \frac{n}{L * w}$$

$$N = A * D$$

D = Density
n = number of observed fish
L = length of transect line(s)
w = effective strip width
N = number of fish in area (A)
A = size of study area

Buckland et al. 2001

Biomass Estimate, product of:
- density (and variance) from transects
- average weight (and variance) of fish
- area of rocky habitat (geophysical data)

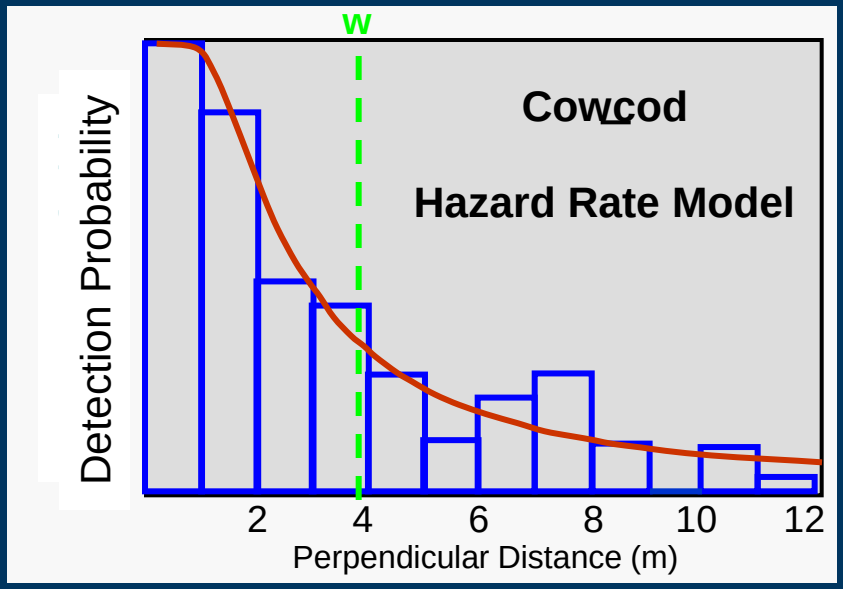
Effective strip width

Assumption: Probability of detection related to distance from transect line.

Plot frequency distribution of sightings vs. distance.

Estimate probability density function, f(distance).

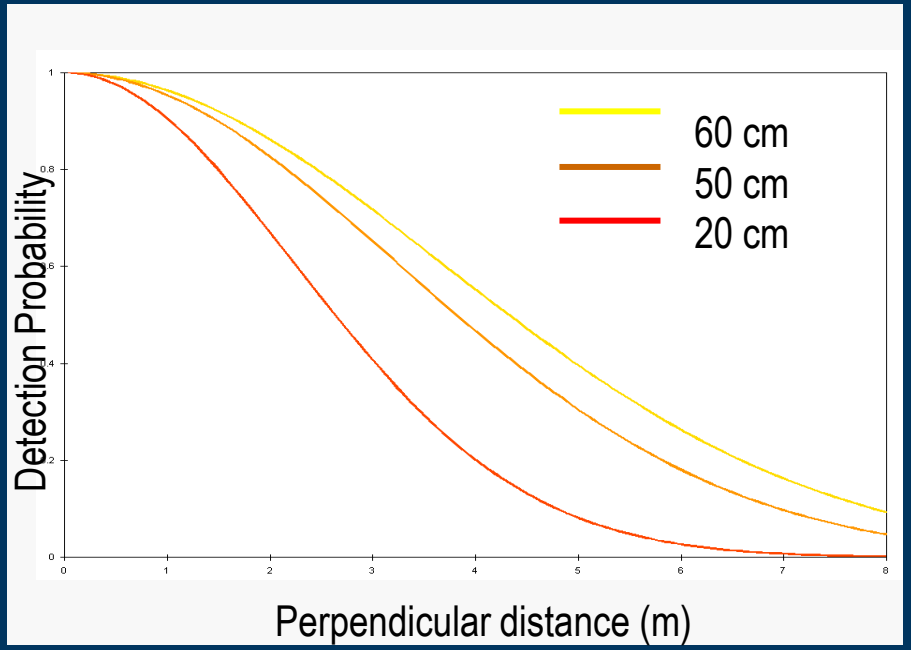
Effective strip width, **w** = 1/ f(0)



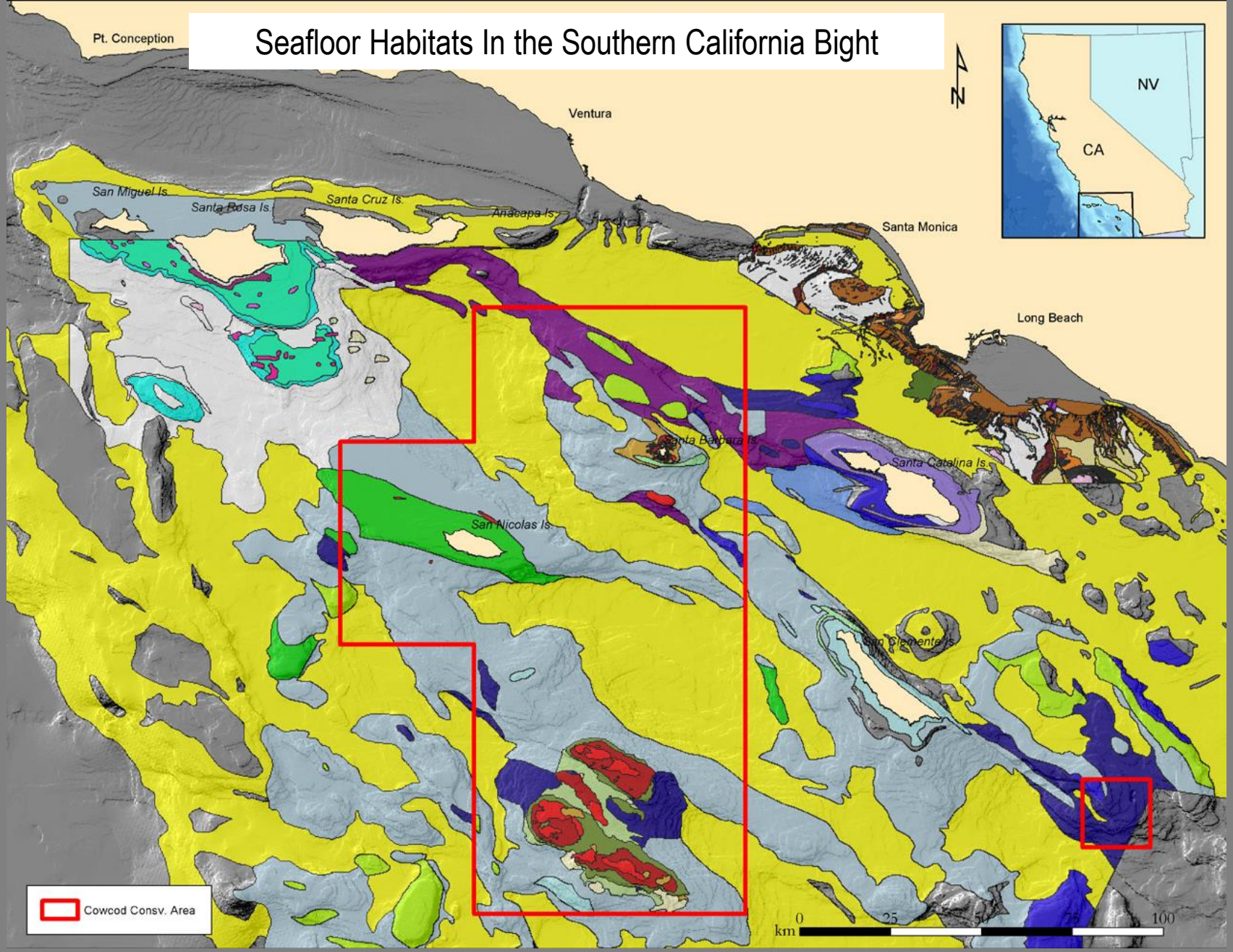
Fish size is covariate in model

Provides size-specific detection functions

Improves precision of analysis



Seafloor Habitats In the Southern California Bight



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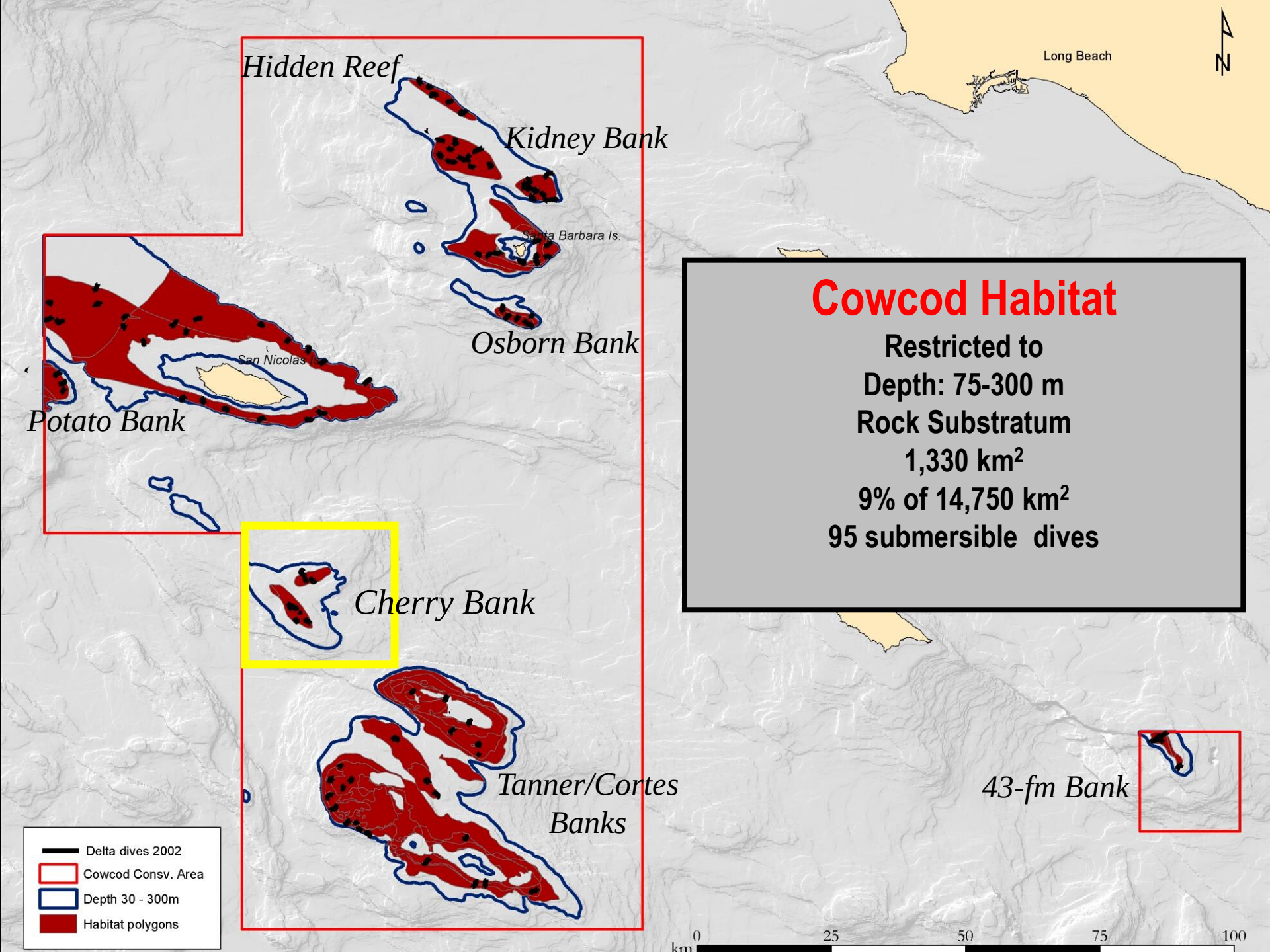
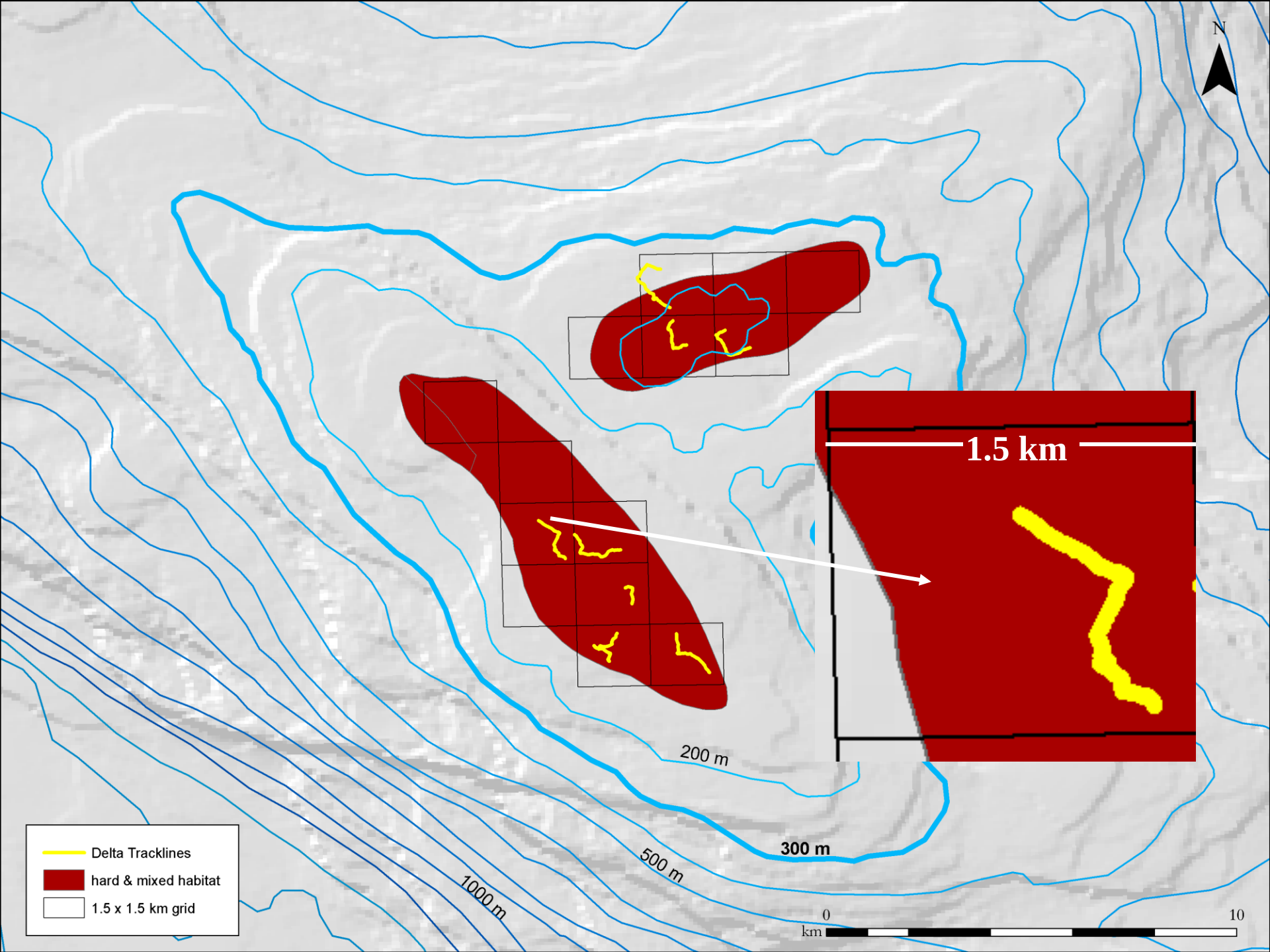
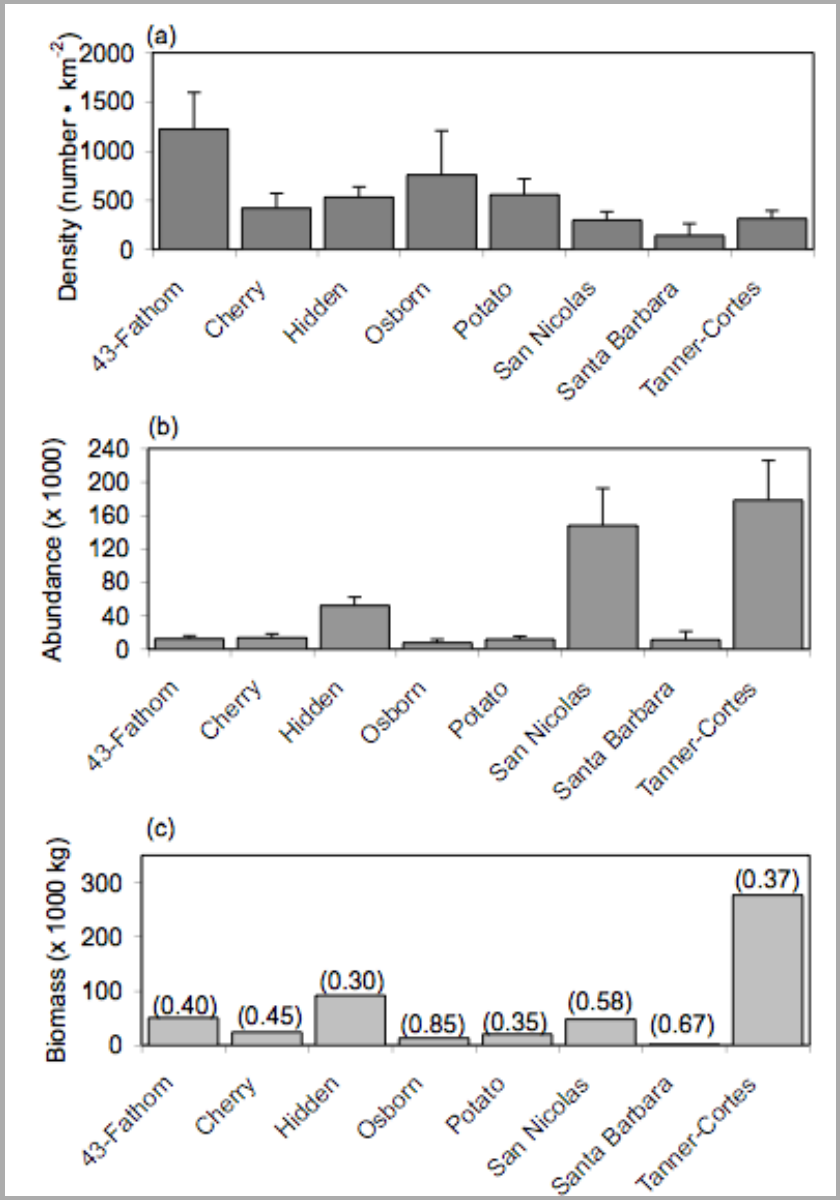

Hidden Reef
Kidney Bank
Santa Barbara Is.
Osborn Bank
San Nicolas
Potato Bank
Cherry Bank
Tanner/Cortes Banks
43-fm Bank
Long Beach
N
Cowcod Habitat
Restricted to
Depth: 75-300 m
Rock Substratum
1,330 km2
9% of 14,750 km2
95 submersible dives
Delta dives 2002
Cowcod Consv. Area
Depth 30 - 300m
Habitat polygons
0
25
50
75
100
km


N
1.5 km
200 m
300 m
500 m
1000 m
Delta Tracklines
hard & mixed habitat
1.5 x 1.5 km grid
0
10
km

Cowcod Survey on Rocky Banks



Overall Assessment

Statistic	Estimate
Number of observed fish	207
Total length of trackline (m)	132,363
Density [D] (no./km2)	328
Habitat (sq km)	1,326
Abundance (N)	435,366
CV (Abundance)	0.20
Mean Weight (kg)	1.93
CV(Mean Weight)	0.14
Biomass (kg)	524,278
CV (B)	0.26
Lower 95% CL biomass (kg)	318,571
Upper 95% CL biomass (kg)	862,814

CV (N) based on DISTANCE bootstrap

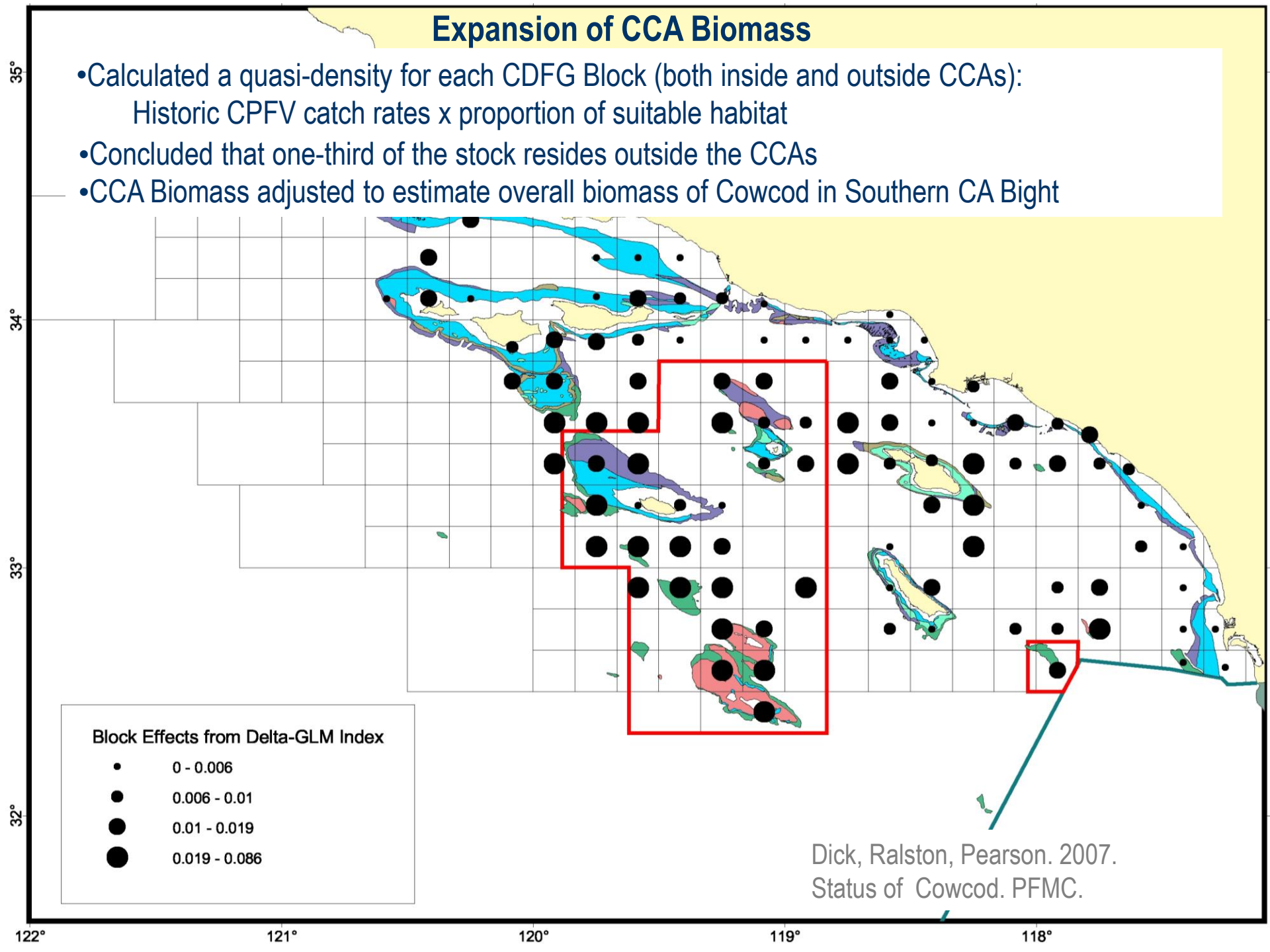
CV (B) based on delta method

Yoklavich, Love, Forney. 2007.
Can. J. Fish. Aq. Sci.

How do you expand results from survey area to entire Southern California Bight?

Expansion of CCA Biomass

- Calculated a quasi-density for each CDFG Block (both inside and outside CCAs):
  Historic CPFV catch rates x proportion of suitable habitat
- Concluded that one-third of the stock resides outside the CCAs
- CCA Biomass adjusted to estimate overall biomass of Cowcod in Southern CA Bight

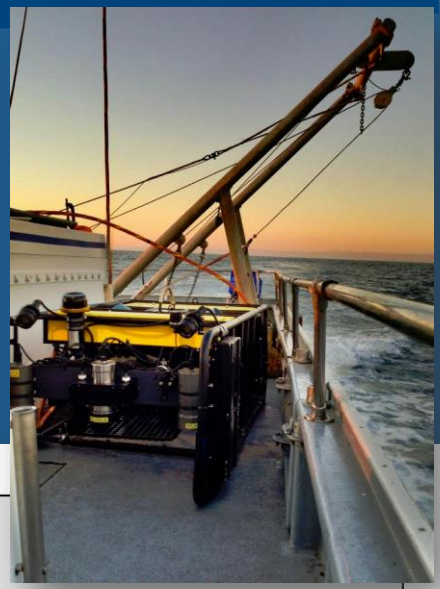


Dick, Ralston, Pearson. 2007.
Status of Cowcod. PFMC.

History of Cowcod Survey

• 1st Cowcod Survey	Oct-Nov 2002
• Seafloor Mapping	August 2003
• Cowcod Report	November 2004
• La Jolla CIE Review	December 2004
• Response to Review	March 2005
• Revised Analyses	May 2005
• STAR Panel	May 2005
• Calibration Surveys	September 2005
• Seafloor Mapping	Oct-Nov 2005
• CJFAS Publication	December 2007
• Cowcod Assessment	2007, 2009, 2011, 2013
• 2nd Cowcod Survey	Oct-Dec 2012

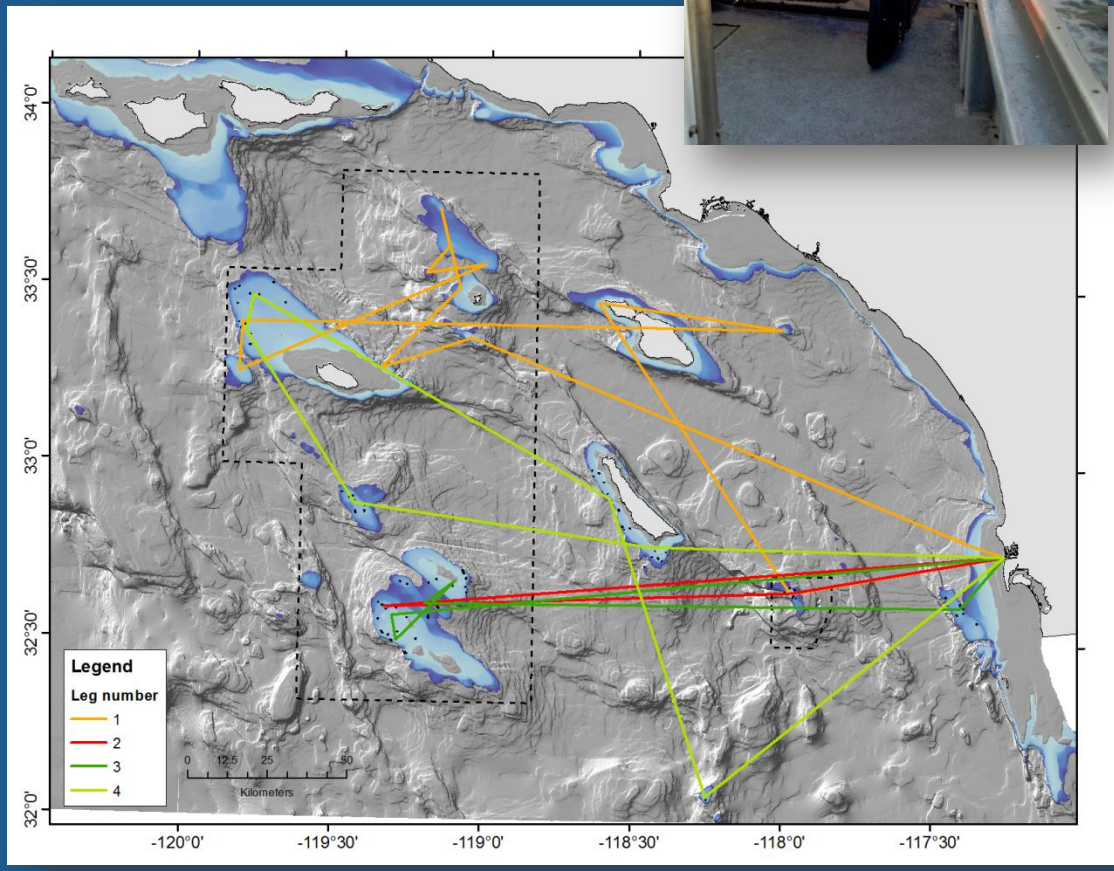
2012 Cowcod Survey



Goal: To conduct a Bight-wide survey of most cowcod habitat

1. To examine population trends since the survey in 2002
2. To identify potential effects of the CCAs

- 18 sites surveyed using a ROV
- 28 days at sea
  - Four legs
  - October - December 2012
- 167 transects totaling ~85 km and 78 h of bottom time
  - Mean transect distance: 519 m
  - Mean transect duration: 28 min
- 189 cowcod observed
  - 9 – 78 cm total length
  - 73 – 275 m depth
  - Mud to high-relief rock habitat

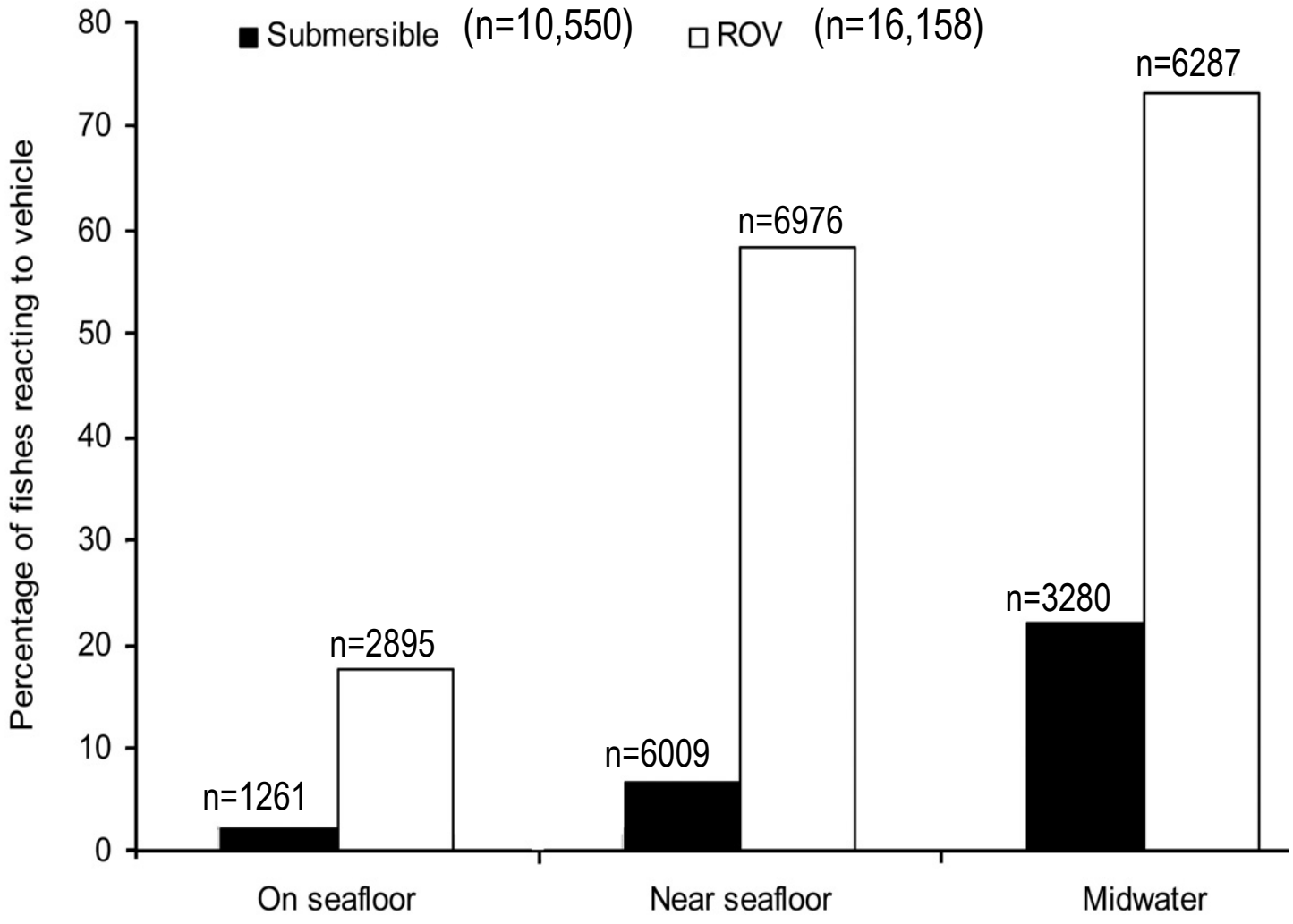


Potential Sources of Bias and Uncertainty in Visual Surveys

- Species detection (encounter rate)
- Species identification (rockfishes are a diverse group of similar-looking species)
- Attraction or avoidance to survey vehicle
- Underwater measurements (sizes, distance, effort)
- Selectivity by habitat (ability to adequately survey high-relief habitats; deep water; patchy spatial distributions)
- Uncertainty in the distribution/abundance of seafloor bottom types

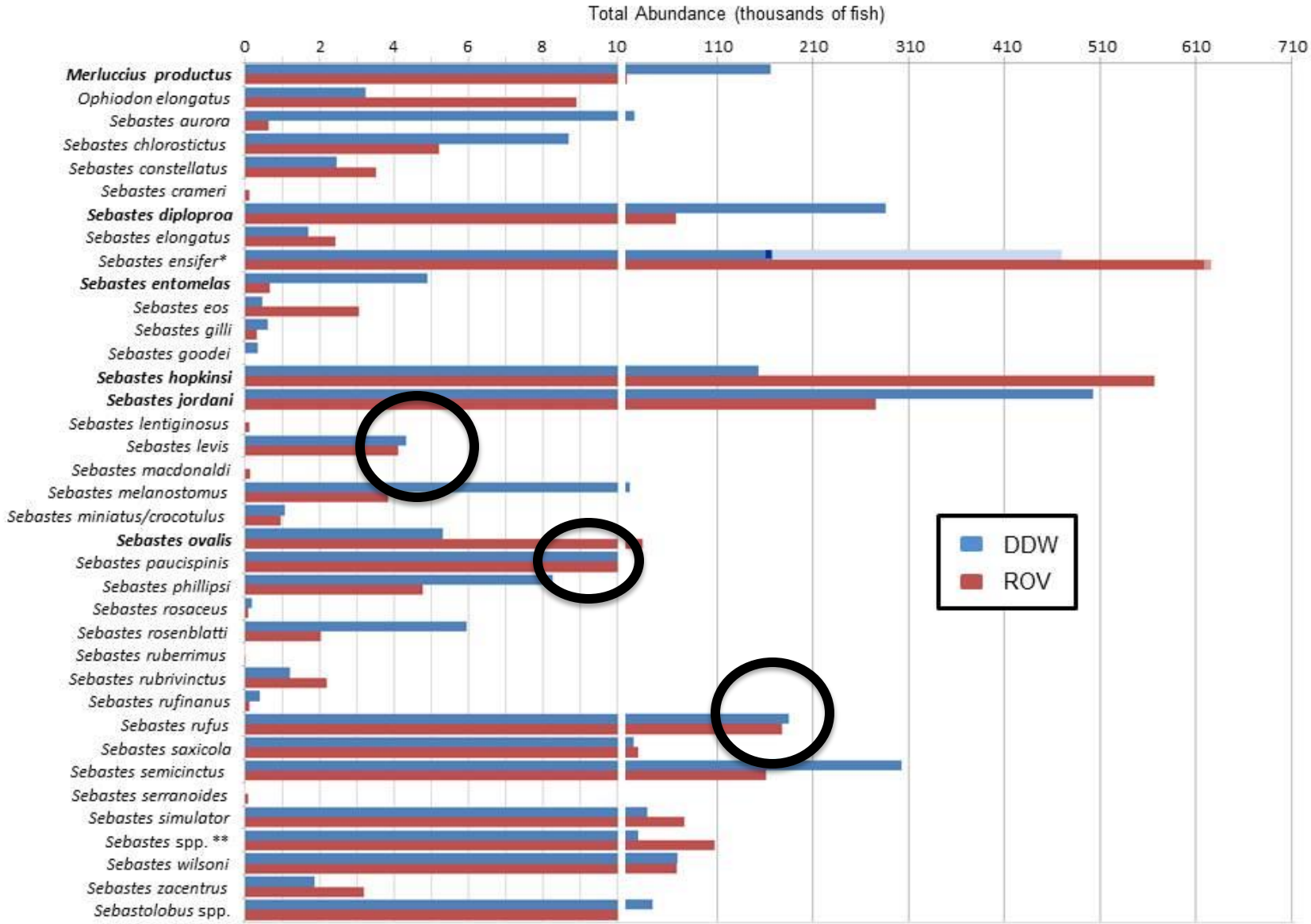
Reaction of fishes to survey vehicles

Definition of 'Reaction': *a distinct movement >1 body length from initial position of the fish*



Laidig et al. 2013 Fishery Bulletin

2011 Visual Surveys of Groundfishes on Untrawlable Habitat Using Manned Submersible and Phantom ROV



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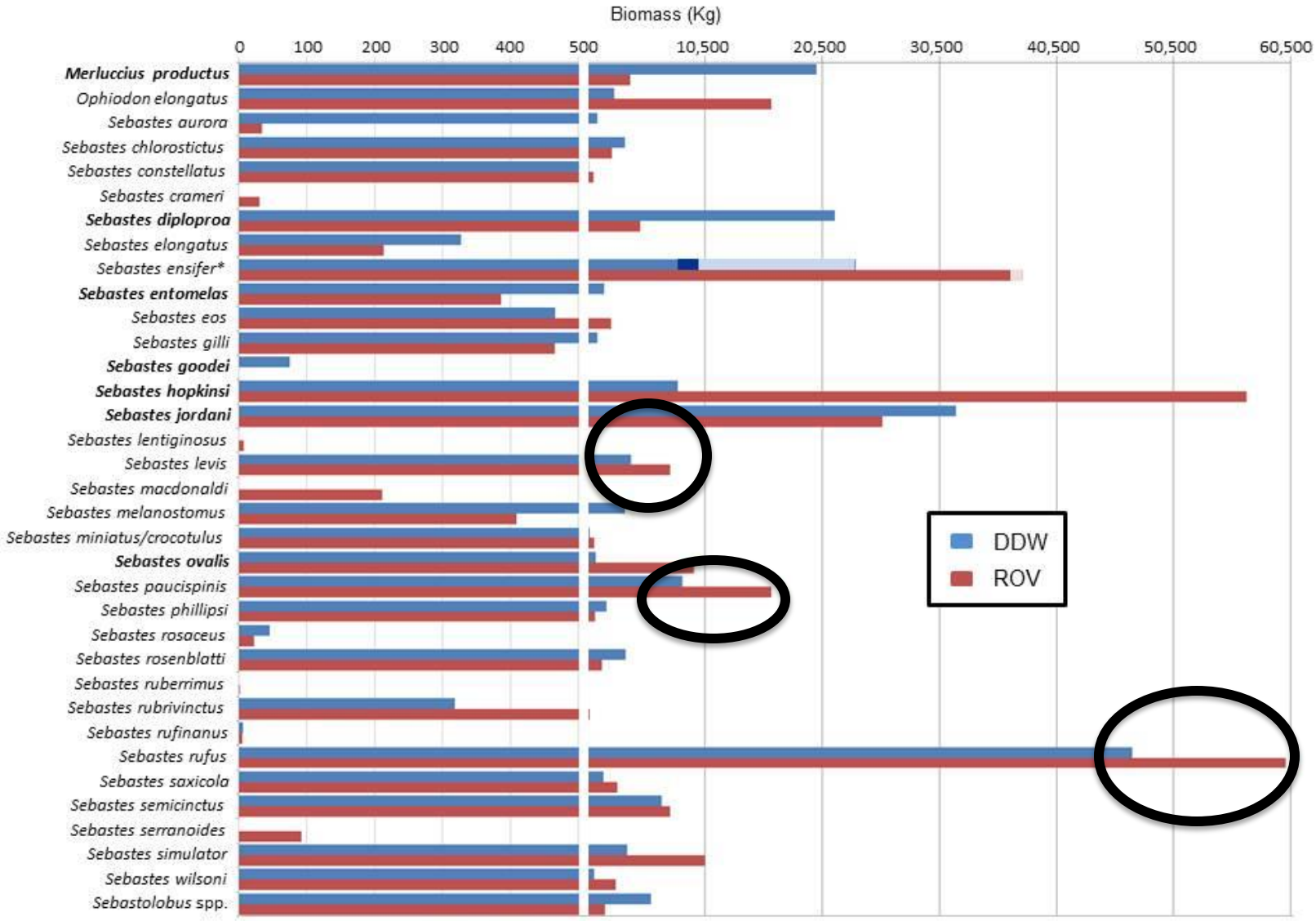

Benefits of Habitat-specific Visual Surveys

- Provide estimate of absolute abundance of cowcod (and many other rockfish species) in untrawlable habitats
- Improve the precision of estimated abundance
- Non-extractive methods ideal for species of low abundance and restricted catches
- Non-destructive methods required to protect sensitive habitats co-located with cowcod
- Provide data to quantify fish-habitat associations; deepsea coral communities; marine debris
- Provide information on a more complete ecosystem
- Inform management: Cowcod Assessment; PFMC EFH review; design/monitoring of MPAs

Challenges to Using Visual Surveys

- Limited availability of adequate survey vehicles and appropriate support vessels
- Limited high-resolution multibeam bathymetry for survey design and analyses
- Inter-calibration of survey results among different survey vehicles is necessary
- Resultant large volume of digital imagery (need effective data storage, processing, quality control)

Solutions

- Support of a visual survey on a regular basis (commitment and funds)
    - Time series of absolute abundance needed to evaluate recovery
- More high-resolution mapping of untrawlable habitat (new NOAA ships with ME70 multibeam sonar)
    - Increase efficiency of survey
    - Increase cost-effectiveness of survey
    - Improve precision of estimates
- Produce fishery-independent assessments for other demersal stocks (e.g., Bocaccio, Starry, Rosethorn, Greenspotted)